Human micro-vascular endothelial cell attachment and tube formation on balloon expanded stainless steel Stents coated with DLC and Si-DLC thin solid films

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Stainless steel stents commonly used for surgical percutaneous transluminal coronary angioplasty have been coated with diamond like carbon (DLC), DLC with Si-sub-layer and with Si-doped DLC; and have been examined after balloon expansion for material coating durability, haemocompatibility and endothelialisation potential. The surface energy of the coatings, the thin solid film coating adhesion to SS, crack propagation based on Weibull-like analysis of these coatings show changes under tensile forces of clinical balloon expansion. The haemocompatibility was examined by assessing the growth, adhesion and proliferation of human micro-vascular endothelial cells (HMECs) on the stents standing in 3-dimensional geometry inside test tubes containing HMECs in suspension for ~ 6 hrs ('upper limit time scale' for cell attachment). It seems that HMECs attach to the stents mesh at certain distances apart following expansion (Fig. 1) in order to successfully form tubes necessary for re-vascularisation, endothelialisation and for preventing re-stenosis. Endothelialisation of the stent's 2/3-dimensional side walls is desirable but at same time any 'cross bridges' or tissue tending to form across the stent tubulule (central/long axis or diameter) is unwanted since this could encourage tissue hyperplasia, narrowing and in-stent restenosis. Both the tubular diameter/cross-section of the non-expanded and expanded stents if wide enough should not encourage this process. The mechanical and micro-structural properties of the stent material and/ or the coating are important consideration. It is desirable that the stent materials and/ or coating materials are malleable enough (and that the coating has good substrate adhesion and minimal intrinsic stress) such that on balloon expansion the surface properties are not greatly altered and the micro-cracks forming on the thin solid film coatings are minimal.

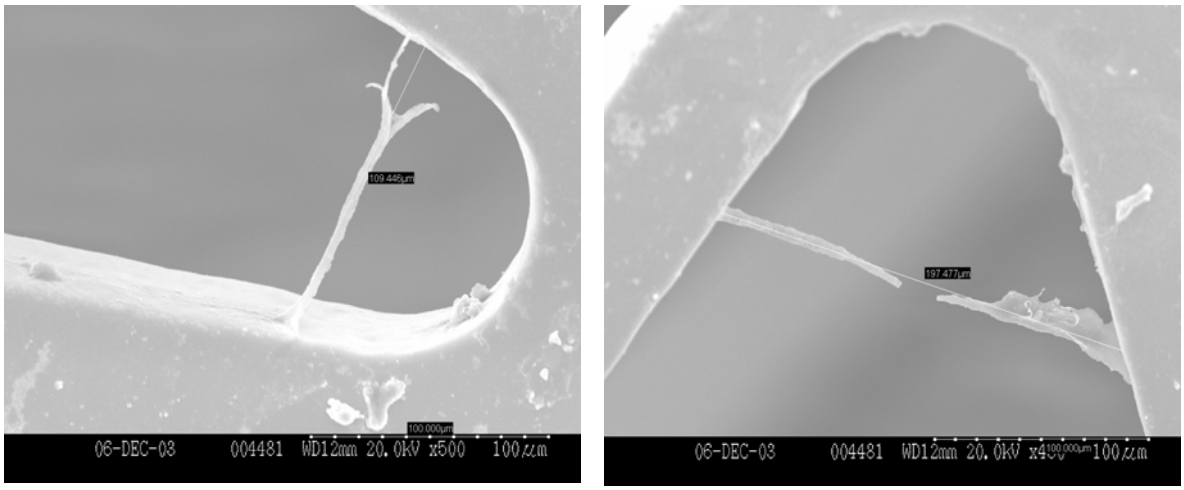

Fig. 1: SEM image of HMEC tube formation on SS-Stent coated with Si-sub-layer-DLC thin solid films.

The thin solid film coatings were done under RF 13.56MHz PECVD system with acetylene, Argon and Tetramethylsilane feed gases. XPS, Raman, SEM, contact angle and statistical analysis were done.

Keywords: DLC, Stents, endothelial cells, adhesion, micro-vessels/tube formation

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